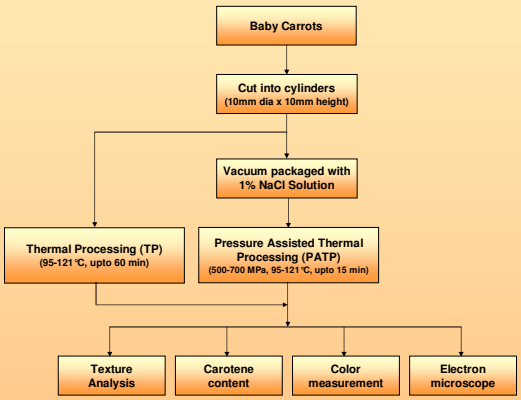
EVALUATION OF INSTRUMENTAL QUALITY OF PRESSURE-ASSISTED THERMALLY PROCESSED CARROTS

Loc Thai Nguyen, N. K. Rastogi and V. M. (Bala) Balasubramaniam

INTRODUCTION

- Pressure-assisted thermal processing (PATP) is a recently emerged, alternative processing technology for low acid foods due to the growing consumers' demand for better quality of foods.
- It involves simultaneous application of pressures (500 to 700 MPa) and temperatures (95 to 121 ℃) to a preheated food.
- Uniform compression heating and rapid cooling reduce severity of thermal effects and preserves food quality, especially texture, color and flavor.
- Systematic studies were conducted to evaluate the role of pressure in preserving food under comparable process temperatures.
- Such comparison would help the food industry to make informed decisions as to the commercial viability of introducing PATP treatment.
- The objective of present work is to compare the effect of PATP and thermal processing (TP) on the quality attributes of processed carrots.

MATERIALS AND METHODS



RESULTS AND DISCUSSION

Pre-process time:

- In order to evaluate the effect of pressure on quality attributes, the pre-process time for PATP and TP were matched (Fig. 1).

Effect of PATP and TP on texture:

- During the TP, the loss of hardness was higher as compared to PATP
- During PATP, up to 105 ℃ the loss of texture was dependent on pressure. At 121 ℃, pressure dependence reduced.
- At 500 MPa, 121 ℃, the increased loss of texture (83.95%) as compared to 700 MPa, 121 ℃ (37.91%) was due to exposure to the higher preheating temperature and temperature before pressurization (59.4 and 86.1 ℃, respectively).

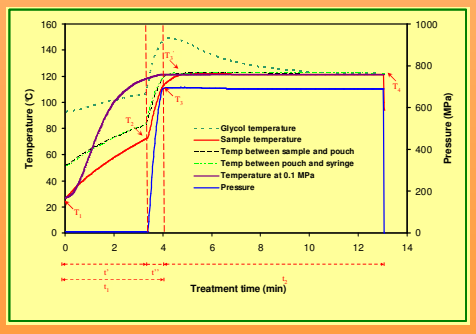


Fig. 1: Sample pressure-temperature history. t', t'', t_1 and t_2 are the time of preheating, compression, pre-process time and holding time, respectively.

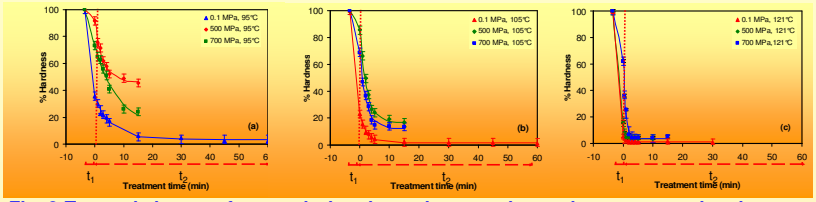


Fig. 2:Textural change of carrot during thermal processing and pressure-assisted thermal processing (a) 95 ℃, (b) 105 ℃ and (c) 121 ℃

Effect of PATP and TP on Color

- PATP had better color retention as compared to thermal processing.
- Color degradation was pronounced in pre-process time
- Maximum loss of color was at 500 MPa, 121 ℃

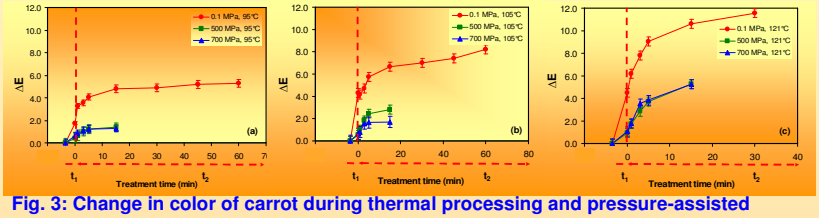


Fig. 3: Change in color of carrot during thermal processing and pressure-assisted thermal processing (a) 95 ℃, (b) 105 ℃ and (c) 121 ℃

Effect of PATP and TP on carotene:

- PATP had better carotene retention at 105 ℃ than thermal processing.
- At 121 ℃, carotene retention was not significantly different at different pressures.

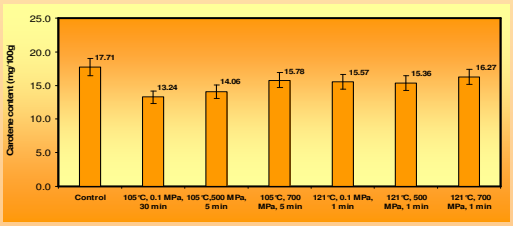


Fig. 4: Variation of carotene during TP and PATP

Effect of PATP and TP on microstructure

- Fresh carrot cells: Clearly defined cell walls, almost isodiametrical & polyhedral cells with intercellular spaces.
- PATP carrot (700 MPa, 105 ℃, 5 min): Cell structure was close to the control sample, which evidenced the minimum cell damage during processing.
- TP carrot (105 ℃ for 30 min): Separated and ruptured cells and non-distinct middle lamella as compared to control because of degradation of pectinacious material.

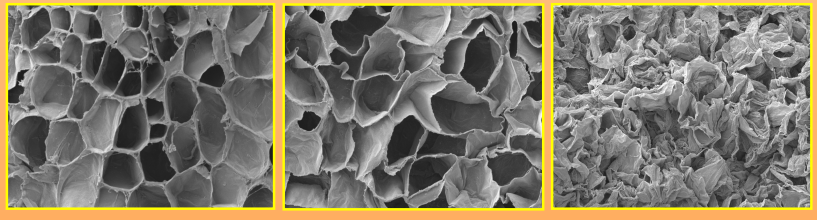


Fig. 5: Microstructures of (a) control; (b) pressure-assisted thermal processed (700 MPa, 105 ℃, 5 min); and (c) thermal processed (105 ℃, 30 min) carrot samples.

CONCLUSION

- PATP conditions up to 105 ℃ were found to protect the quality attributes (such as hardness, color and total carotene content) of carrot as compared to thermal processing.
- At 121 ℃, potential benefits of PATP were not observed due to predominance of temperature
- Due to uniform heating and cooling during pressurization and depressurization as well as less processing time, PATP may be more effective in case of larger sample size as compared to thermal processing.

REFERENCE

Krebbers B, Matser AM, Hoogerwerf SW, Moezelaar R, Tomassen MMM, van den Berg RW. 2003. Combined high-pressure and thermal treatments for processing of tomato puree: evaluation of microbial inactivation and quality parameters. Innov Food Sci Emerg Technol 4(4): 377-85.

ACKNOWLEDGEMENT

Financial support for the research was provided in part through grant from the Center for Advanced Processing and Packaging Studies (CAPPS).

Department of Food Science & Technology, The Ohio State University, Columbus, OH - 43210